Roll front type U-ore redistribution in unconformity related deposits

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Basement-hosted unconformity-related U deposits of the Athabasca Basin (Canada) were affected by significant U redistributions along roll-fronts related to late meteoric-derived fluid percolations. The uranium roll-fronts exhibit the same features as the well-studied U roll-front deposits known in silico-clastic formations. The hydrothermal primary ores were strongly reworked in new disseminated ores formed of 3 distinct zones: a white-green zone corresponding to the previous clay-rich alteration halo, a U-rich front and a red zone, hematite-rich. The three zones reflect the mineralogical zoning mainly of U-oxides, sulphides, iron and Al-phosphate-sulphates minerals. U-oxides from the roll fronts are enriched in LREE. The U roll-fronts were produced by the percolation of oxidizing, cold (<50°C) meteoric-derived fluids, initialized during the 400-300 Ma period, in the previous hydrothermal alteration zones. U, Fe, Ca, Pb, S, REE, V, Y, W, Mo and Se are the most mobile elements and their distribution within the 3 zones directly depends of their redox potential.

Modeling geochemical self-organization and dynamics: Strategy, feedbacks, testing. Dolomitization.

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Many geochemical self-patterned structures and textures exist in nature: banded-iron formations; bedded cherts; agate, pisolitic, liesegang, and orbicular bandings; planar igneous and metamorphic bandings; dolomitic zebra veins and burial dolomitization; sets of stylolites; karst sinkholes; oscillatory zoning; etc. Each is unique. Disequilibrium and feedback (s) are necessary conditions for self-patterning. Many possible reaction-transport feedbacks exist. A model must capture the uniqueness of the phenomenon by incorporating independent evidence – field, chemical, textural – and the correct feedback (s). A linear instability analysis yields a map of system behaviours that may help in testing the model against further evidence [1]. A problem in the dynamic modeling of weathering, burial dolomitization, metamorphism, and ore deposits is to confuse 'mass balances' for local reactions. The mass-conservation eqn requires rates of local reactions in its reaction term. Actual local reactions in rocks often conserve volume, the characteristic of replacement, following from a newly found kinetic-rheological feedback involving the induced stress. In dolomitization, the self-accelerating dolomite-for-calcite replacement forces a rheological transition from replacive to displacive dolomite growth which leads to self-organized, syntaxial zebra veins [2, 3].

[1] Merino & Wang (2001) in *Non-Equilibrium Processes in Geoscience*, Self-Organization Yearbook, **11**, 13–45 (Eds H.J. Krug & J.H. Kruhl). [2] Merino *et al*. (2006) *Geologica Acta* **4**, 383–393. [3] Merino, À. Canals (2010) *Amer. J. Sci*, submitted.